IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Jonathan W. Roberts	***Confirmation No.:***	2701
Serial No.:	10/559,584	***Group Art Unit*:**	1794
Filed:	12/02/2005	***Examiner:***	Jennifer A. Steele
Title:	MICA TAPE HAVING A MAXIMIZED MICA CONTENT		

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this correspondence is being electronically transmitted to Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450, on February 11, 2009.

Alana M. Fuierer

Date of Signature: February 11, 2009

To: Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Declaration Under 37 C.F.R. §1.132

Dear Sir:

I, **Jonathan Whitney Roberts**, declare:

1. I am the first-named inventor in the above-identified application, and wish to bring to the information presented below to the attention of the United States Patent Office.

2. I reside at 484 Salter Hill Road, Arlington, Vermont 05250.

3. I have a degree in Chemical Engineering from the University of Maine. I also have a degree in Business Management from the University of New Hampshire.

4. I have worked in the electrical insulation and rigid laminates industry since 1977.

5. I have a combined total of 31years industrial and academic experience in the manufacture of high voltage insulation, including mica tape insulation.

6. Between 2002 and 2003, I was GM of US Samica Corporation, a Quin-T company, one of the first companies to specialize in the manufacture of mica papers, tapes and wrappers for the electrical industry. Between 2001 and 2002, I was the Corporate Technical Director for the Quin-T Group.

7. In 2003, US Samica became Isovolta, Inc., a member of the Isovolta Group. Isovolta, Inc. is the last remaining mica paper manufacturing plant in North America, and is the only producer with the onsite capabilities of designing mica paper to optimize specific performance characteristics required by a specific application. Since 2003, I have remained Chief Executive Officer of Isovolta, Inc./US Samica ("Isovolta, Inc.").

8. Isovolta, Inc. has offices at 477 Windcrest Road, Rutland, Vermont 05702.

9. My main areas of responsibility as CEO of Isovolta, Inc. include:

- The development and optimization of mica tapes suitable for low and high voltage insulation.
- The design and implementation of new insulation technology for electrical generators
- Operations Management
- Technical sales and sales management.
- Research and development.
- Parts and Labor responsibilities

10. I am the first-named inventor on U.S. Patent Application No. 10/559,584, filed December 2, 2005. The U.S. utility patent application derived from International Patent

Application Number PCT/US04/29849, filed on September 15, 2004 and bearing a priority date of June 16, 2004. U.S. Patent Application No. 10/559,584 has been assigned to Isovolta AG.

11. I am also the sole named inventor on U.S. Patent No. 4,704,322 (Roberts '322 Patent), entitled Resin Rich Mica Tape and issued on November 3, 1987, which is cited art in the Office Action.

12. I am familiar with the subject matter disclosed and claimed herein, as well as the test data collected regarding the claimed subject matter since this filing.

13. In support of the non-obviousness of the pending claims, I present herewith an explanation of why the pending claims would not have been obvious to myself or other experts in the field based on the applied prior art.

Background – Mica Tape Insulation

14. In addition to various other applications, mica tapes are used as high voltage insulation barriers in the manufacture of high voltage electrical motors and generators.

15. The use of high voltage insulation in electrical machines is one of the main components responsible for the historical evolution dictating the power output of such machines.

16. In order to further increase the power output of a high voltage generator, improvements to glass cloth backed mica tapes may include:

- Increase thermal conductivity
- Increase electrical field strength
- Increase mechanical features

Over the past 20 to 30 years, and since I obtained the '322 patent, however, there have not been any novel steps forward in the further development and improvement of mica tape insulation for

high voltage generators. Small improvements have been made on the raw material side and in the resin formulations, but these are simply minor contributions to the basic design.

Unexpectedly Enhanced Characteristics of Claimed Mica Tape Insulation

17. Porofab® is Isovolta Inc.'s commercial embodiment of the novel, high voltage insulation material comprised of a mica layer disposed on a twist-free glass fabric layer that is developed using vacuum pressure impregnation (VPI) technology in accordance with the claimed features. Calmicafab® is the trade name for the novel, high voltage insulation material comprised of a mica layer disposed on a twist-free glass fabric layer and developed using resin rich (RR) technology in accordance with the claimed features.

18. I submit this Declaration in support of my belief that the claimed features of the electric insulating material, which comprises a mica layer disposed on a glass fabric comprised of twist-free fibers, is novel and nonobvious, due in part to the amendment of the claims submitted herewith.

19. I also submit this Declaration in support of my belief that combination of the cited art Scari and the resin-rich mica tape disclosed in the Roberts '322 Patent would not inherently comprise the observed and claimed properties of a higher temperature resistance, a significantly lower dissipation factor and an operation temperature of 450-1100° C, nor would the combination be expected to result in a) the ability to significantly lower, in the order of approximately 21%, the amount of organic resin required; b) a substantial decrease of approximately 15-18 % in the mica tape total thickness; c) a substantial improvement in thermal conductivity for both VPI and RR mica tape insulation; d) a higher electric field strength; and e) an outstanding and highly unexpected increased resistance to layer-to-layer delamination during thermal cycling.

20. Most significantly, as detailed in Paragraph 26 below, the substantially improved resistance to layer-to-layer delamination during thermal cycling was highly surprising and unexpected, and would not be an inherent characteristic that would necessarily result from the combination of Scari and the Roberts '322 Patent.

21. The aforementioned substantial and unexpected improvements to critical properties of high voltage insulation mica tapes, as compared to the standard mica tape insulation, all while maintaining and/or enhancing the appropriate mechanical properties necessary for application to high voltage generators, has resulted in the greatly unexpected advantage of allowing one to increase the specific power output of a high voltage generator that is kept at the same frame size.

22. I also submit this Declaration in support of my belief that one of skill in the art who manufactured mica tapes would not have expected the combination of Scari and the resin-rich mica tape disclosed in the Roberts '322 Patent to be effective in substantially increasing the thermal conductivity and power output as set forth below.

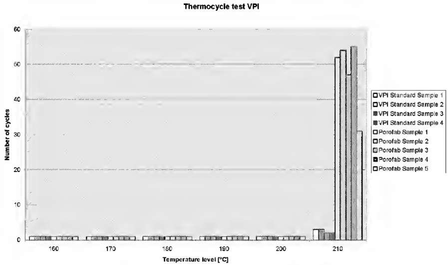
23. In support of the claimed features, I present herewith experimental details and data from tests performed on both Porofab® and Calmicafab® at Isovolta's application laboratory under the direct supervision and control of Michael Raber. These tests have shown that the claimed features have resulted in the following unexpected results.

24. In accordance with the claimed features, both Porofab® and Calmicafab® utilize zero-twist or twist-free glass yarn.

25. During the design phase of a mica insulation tape, it is important that special attention be given to the bond strength between the glass and the mica to prevent delamination during its application. The zero-twist yarn has a lower profile "knuckle," which minimizes the

void volume in the glass cloth, while maximizing the contact surface (i.e. bonding area) between the mica tape and the glass fibers. During both the VPI and the pressing process of resin rich technology, the voids are filled with organic resins. Having minimized the void volume within the insulation, the amount of required organic resin has also been minimized, in the order of approximately 21%.

26. Although one may have expected a slight increase in bond strength, the behavior of the claimed insulation during thermal cycling has been found to be overwhelmingly and surprisingly improved when compared to standard mica tape insulation.



Thermal cycle tests of VPI insulation

As can be seen in the above chart, it has been unexpectedly found that the claimed mica tape insulation will last 4 to 5 times longer than the standard constructions when cycling up to 210°C. This is a substantial increase as compared to standard mica tapes, and the result was highly unexpected and could not have been predicted. One of ordinary skill in the art would not predict that a combination of Roberts and Scari would result in such a substantial increase in thermal cycling properties.

27. Tests also were performed to establish the mechanical, electrical and thermal properties of the Porofab® insulation containing an epoxy anhydride resin system.

28. The claimed features of the high voltage insulation material include a glass cloth with a thickness ranging most preferably from 1 mil (0.025 mm) to about 3 mil (0.076 mm). This glass cloth comprised of the zero-twist fibers is significantly thinner than the glass cloth currently used, and yet it has the identical or even greater base weight.

29. The figure below shows the ability of the claimed features to unexpectedly reduce the total thickness of insulation material as compared to standard tapes, while maintaining mechanical properties, such as tensile strength, flexural strength and tear edge strength, at the same or greater values as compared to the standard insulation.

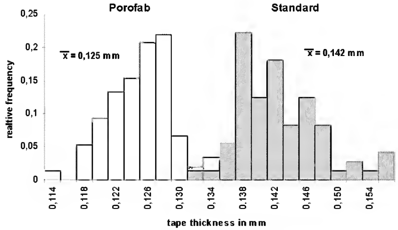


Figure 3: Thickness comparison a standard 0.14 tape and Porofab®

The average value of the standard material is about 0.142 mm, while the average value for the Porofab® tape is about 0.125 mm. With the claimed technology, a substantial decrease of approximately 15-18% of the mica tape total thickness can be achieved.

When the same number of Porofab® layers vs. standard mica tape were taped onto test bars, the total thickness of the insulation build with Porofab® is about 20% thinner as compared

to the insulation build using standard tape. Similar thickness reduction, in the range of 15%, can be reached with the Calmicafab® mica tapes. Despite these substantial thickness reduction, as unexpectedly seen below, all other mechanical properties such as tensile strength, flexural strength and tear edge strength of the claimed mica tape insulation show at least the same or greater values as compared to the standard insulation thickness build.

Specifically, one of ordinary skill in the art would not predict that a combination of Roberts and Scari would result in the following improvements.

A) ***Tear Edge Strength*** - It is important to have a good mechanical strength on the edge of the high voltage insulation material. Eliminating tape breakage can save a lot of time during coil or bar production. As noted in the Figure below, due to the unexpected high tear edge strength of the mica tape insulation as claimed, unexpectedly higher taping speeds and taping tension around the corners is possible.

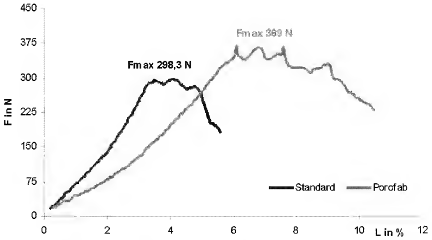
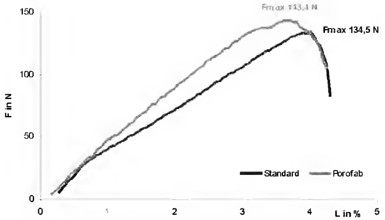


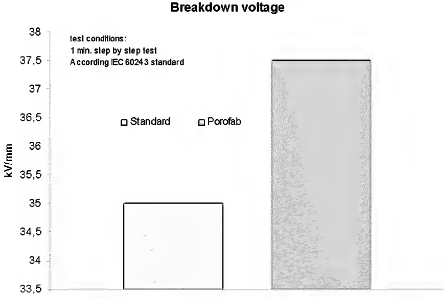
Figure Measurement of tear edge strength

B) ***Tensile Strength***- Despite the total thickness reduction in the mica insulation as claimed, the tensile strength unexpectedly is in the same range as a mica insulation comprised of standard glass cloth as noted in the Figure below.



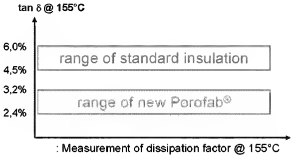
Measurement of tensile strength

C) *Breakdown Voltage* - To be able to compare the dielectric breakdown voltage measurements between the standard tape and claimed mica tape insulation, the same numbers of layers were taped onto the test bars to yield the same amount of mica in the insulation build. Significantly, as noted in the below figure, although the mica content is the same, the claimed mica tape insulation breaks down at an unexpectedly higher stress level than the standard tape.



Measurement of breakdown voltage

30. The dissipation factor at rated thermal classifications characterizes the finished laminated quality of the mica tape insulation, the uniform distribution of the VPI resin and overall tape to VPI resin compatibility. The lower the value is, the better the inner layer fill and bonding. As seen in the figure below, the claimed mica tape insulation values are much lower than the values obtained with the standard material.



These very low values, which indicate that the bond between the individual layers and resin fill is excellent, were highly unexpected and significant, as over the past 20 years these values have not been achieved despite prior optimization efforts that included adjusting paper design in regards to particle size and formulation modifications.

31. Standard VPI mica insulations can achieve a thermal conductivity of about 0.28 W/mK, while standard RR mica insulations can achieve a thermal conductivity of about 0.25 W/mK. Prior efforts to optimize and increase the thermal conductivity of mica insulation tapes have included adding metallic fillers into the mica tapes. By using this optimization technique, the highest thermal conductivity achieved is approximately 0.55 W/mK. However, the disadvantage of this technology is that the thickness of the mica insulation tape is much higher when compared to standard mica tapes.

32. On the other hand, the claimed mica tape insulation allows one to significantly increase thermal conductivity without an increase in total thickness of the insulation, while at the same time retaining the same mechanical and electrical properties as compared to the standard insulation thickness build. For example, Porofab® tape insulation with a 1.4 mm thickness is able to obtain the same thermal conductivity as a metallic-filled tape with a 2 mm main wall thickness. The reduced thickness also allows one to build two additional layers of tape, which results in 320 g/m² more mica in the ground wall, which in turn directly results in better life endurance.

	Mica [%]	Resin [%]	Glass cloth [%]	λ [W/mK]	E_{max} [kV/mm]	Possible therm. class	d [mm/ 18kV]	TTC [W/m²K]
RR Standard	54	36	10	0.25	2.75	155	3.8	**66**
Calmicafab® (RR)	57	33	10	0.27	3.4	155 – 180	3.1	**87**
Calmicafab® (RR)	57	33	10	0.27	3.7	155 – 180	2.8	**96**
VPI Standard	62	28	10	0.28	2.75	155	3.8	**74**
VPI Standard	62	28	10	0.28	3.0	155	3.6	**78**
Porofab® (VPI)	67	22	10	**0.365**	**3.5**	180	3.0	**122**
Porofab® (VPI)	68	22	10	**0.365**	**4.0**	180	2.6	**140**

As can be seen from the above Table, Porofab® tape insulation is able to achieve a thermal conductivity of 0.36-0.37, as compared to 0.28 W/mK for a typical VPI mica insulation. This translates to an unexpected 28% improvement in thermal conductivity. Calmicafab® tape insulation is able to achieve a thermal conductivity of 0.27, as compared to 0.25 W/mK for a typical RR mica insulation. This translates to an unexpected 8% improvement in thermal conductivity.

33. In sum, the claimed features have the following highly, unexpected improved properties:

a. A substantial increase in thermal conductivity for both VPI and RR mica tapes
b. Better bonding of layers, resulting in better thermal cycling properties and better resistance to delamination at elevated temperatures
c. Higher electric field strength
d. Reduced mica tape thickness
e. Higher tensile strength
f. Higher tear edge strength
g. Lower flexural strength
h. Increase in mica to glass ratio to optimize mica content.

34. As outlined above, the ability to reduce the main wall thickness of a high voltage generator, and the resulting improvement on the thermal transport from the conductor towards the iron core, results in the unexpected advantage of increasing the specific power output from a generator that is kept at the same frame size. Specifically, it has been unexpectedly found that the relative power output increase for RR systems varies in the range of 5%-15% depending on the machine design and relative insulation thickness reduction, while for VPI systems the increase is slightly higher due to the higher difference of the electrical field strength and can be rated between 6% and 19%. Likewise, because we can achieve the same power output with a reduced frame size, it is possible to optimize and save on the cost of heavy framing steel.

<u>Non-Obviousness of Claimed Features</u>

35. I am familiar with the contents of the Office Action dated December 11, 2008, wherein the Examiner has rejected claims 1-5, 7-13 and 19-28 under 35 U.S.C. §103(a), as being unpatentable over the Roberts '322 Patent, in view of Scari (US 5,792,713). For the following reasons, I submit this Declaration in support of my belief that it would not have been obvious to one of ordinary skill in the art to substitute Scari for the conventional glass cloth employed in the resin rich mica tape of the Roberts '322 Patent in order to achieve the claimed features.

36. The Office Action takes the position that one of ordinary skill in the art would be motivated to substitute the zero twist yarn of Scari with the conventional glass cloth of the Roberts '322 Patent because "a tape is a flat profile article and an article where the property of being thin and compact would be desirable," therefore because Scari is known to produce a flatter or thinner profile fabric, there would be motivation to combine the cited art to produce a thin tape. However, contrary to the Office Action's unsubstantiated presumptions, this reduction in overall thickness of the claimed mica tape insulation is non-obvious because there was no motivation to utilize a thinner glass fabric. For example, one of ordinary skill in the art would expect that the use of a thinner glass fabric would result in higher tape breakage due to reduced tear resistance and lower tensile strength. Indeed, over the past 20-30 years, it has not been possible to reduce the thickness of mica tape insulation material for this precise reason.

37. Furthermore, one of ordinary skill in the art would not have been motivated to combine Scari and the Roberts '322 patent because the expected result would be that the mica tape insulation would achieve an undesirable increase in the glass-to-mica ratio in the insulating material. Specifically, Scari teaches that the use of zero-twist yarns allows one to use larger diameter glass fibers, which in turn provides for a greater glass content and also thicker fabric. [Scari, Col. 7, lines 60-65; Col. 8, lines 44-46]. Therefore, because the disclosure in Scari teaches away from a combination of a mica tape and thinner glass fabric to produce a higher mica-to-glass ratio, there would be no motivation to combine the cited art.

38. As to Claims 19-20, the Office Action admits that the cited art does not disclose temperature resistance or operating temperatures of 450-1100° C. Similarly, in discussing Claims 23-24, the Office Action admits that the Roberts '322 Patent does not teach the density of the material or a relative percentage of mica to glass layer (or mica-to-glass ratio). Instead, the

Office Action states that one of ordinary skill in the art could have employed a relative range of mica layer to glass layer or reasonable optimized the layers motivated to achieve the desired properties of the insulating tape to one of skill in the art.

39. As to Claims 25, the Office Action admits that the Roberts ‘322 Patent does not disclose the percentage of polymeric material compared to the glass material and thus a comparison of polymeric material to glass composition cannot be ascertained. Instead, the Office Action states that it would have been obvious to select a percentage of polymer in the range of the Roberts ‘322 Patent and substitute a twist fee glass yarn of Scari motivated to produce a tape that has a thinner profile as Scari teaches the twist free yarn has a lower profile.

40. Similarly, as to Claims 26-27, the Office Action further admits that the Roberts ‘322 Patent does not teach a dissipation factor, however it presumes that the property of the tape would be inherent by the combination of the Roberts ‘322 Patent with Scari.

41. In an attempt to overcome the above admissions, the Office Action takes the position that because mica, glass and polymers have inherent properties that provide heat resistance and dissipation factors, it is presumed that the combination of the Roberts ‘322 Patent and Scari would inherently have all of the claimed properties.

42. However, as shown above, the claimed features are characterized by unexpected, critical properties that are far outside the range of the Roberts ‘322 Patent and are far superior than the cited art. One of ordinary skill in the art who manufactured mica tapes would not have expected the combination of Scari and the resin-rich mica tape disclosed in the Roberts ‘322 Patent to have achieved such unexpected, significant results. Indeed, none of the above conditions are disclosed in the cited art, nor do they necessarily flow from the teachings of the cited art.

43. I declare that all statements for the foregoing Declaration made of my own knowledge are true and that all statements made upon information and belief are believed true and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the above-identified application or any patent issuing thereon.

Signed by me this 11th day of February 2009.

Jonathon W. Roberts